IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF NORTH CAROLINA

VOLUMETRICS MEDICAL IMAGING, LLC,	)	
Plaintiff,	)	
v.	)	No. 1:05CV00955
TOSHIBA AMERICA MEDICAL SYSTEMS, INC. and SIEMENS MEDICAL SOLUTIONS USA, INC.,	)	
Defendants.	)	

MEMORANDUM OPINION AND ORDER REGARDING CONSTRUCTION OF DISPUTED PATENT CLAIM TERMS

This matter is before the Court for construction of disputed patent claim terms in two patents concerning three-dimensional ultrasound technology: 5,546,807 ("the '807 patent"), and 6,276,211 ("the '211 patent"). A Markman hearing was held from May 19, 2008, through May 23, 2008.[1] See Markman v. Westview Instruments, Inc., 52 F.3d 967 (Fed. Cir. 1995) (en banc). The parties returned for additional arguments on claim construction on June 16 and 17, 2011. After consideration of the oral arguments and written briefs [Docs. ## 101-102, 105, 115, 121-123, 125-127, 420, 421, 423, 424], the Court now turns to construing the disputed claim terms.

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[1]An additional patent, 4,596,145, was at issue during the Markman Hearing. The defendant, Medison America, against whom that patent was asserted, is no longer part of the case.

I.

The general rules of patent claim construction are not in dispute. The Court begins by examining the claim language itself. See, e.g., Phillips v. AWH Corp., 415 F.3d 1303, 1312 (Fed. Cir. 2005) (citing Innova/Pure Water, Inc. v. Safari Water Filtration Systems, Inc., 381 F.3d 111 (Fed. Cir. 2004) and Vitronics Corp. v. Conceptronic, Inc., 90 F.3d 1576 (Fed. Cir. 1996)). The claim language is given its customary meaning to a person of ordinary skill in the art at the time of the invention, and is read in the context of the entire patent, including the specification. Id. at 1313-14. Courts may not "rewrite" claims. Haemonetics Corp. v. Baxter Healthcare Corp., 607 F.3d 776, 782 (Fed. Cir. 2010) ("[W]e do not redraft claims to contradict their plain language in order to avoid a nonsensical result."). "However, in clarifying the meaning of claim terms, courts are free to use words that do not appear in the claim so long as 'the resulting claim' interpretation . . . accord[s] with the words chosen by the patentee to stake out the boundary of the claimed property." Pause Technology, 419 F.3d at 1333 (citation omitted). For the two patents in dispute, the parties agree that a person of ordinary skill in the art at the time of the invention would have held at least a Bachelor of Science degree in Biomedical Engineering, Electrical Engineering, Engineering Physics, or a closely related field (such as Physics), and that person would also have had several years of experience in the design or development of medical ultrasound devices. Dock. # 365 (Markman Hr'g Tr. 200-01, May 20, 2008); Dock. # 115-1 (Dr. Walker Decl. ¶ 5 (Jan. 5, 2007)).

Some of the terms to be construed by the Court are written in the means-plus-function format described by 35 U.S.C. § 112 ¶ 6. Section 112 ¶ 6 provides that "an element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure . . . ." Further, the claim "shall be construed to cover the corresponding structure . . . described in the specification and equivalents thereof." 35 U.S.C. § 112 ¶ 6. A court construing a means-plus-function element of a patent claim first identifies the claimed function and then identifies the corresponding structure that performs that function. See, e.g., JVW Enters., Inc. v. Interact Accessories, Inc., 424 F.3d 1324, 1330 (Fed. Cir. 2005).

The use of the word "means" in the claim language creates a presumption that the term is written in means-plus-function format under 35 U.S.C. § 112 ¶ 6. See e.g., Phillips, 415 F.3d at 1311 (explaining that a claim phrase containing the word "means" is "a formulation that would ordinarily be regarded as invoking the means-plus-function claim format"). However, including the word "means" does not automatically make that element a means-plus-function element and not including the word "means" does not automatically prevent that element from being construed as a means-plus-function element under 35 U.S.C. § 112, ¶ 6. Cole v. Kimberly-Clark, Corp., 102 F.3d 524, 531 (Fed. Cir. 1996). Rather, a court decides whether an element is written in means-plus-function format on an element-by-element basis. Id. A claim is not written in means-plus-function format if, for example, the claim recites

sufficient structure to perform the described function or if the claim fails to recite a function associated with the means. Id. ("To invoke this statute, the alleged means-plus-function claim element must not recite a definite structure which performs the described function.").

The parties disagree on the application of these rules and on the more nuanced rules of claim construction. Those issues are discussed in the context of the claim disputes themselves.

II. Claim Construction for the '807 Patent

The '807 patent, entitled High Speed Volumetric Ultrasound Imaging System was issued August 20, 1996. U.S. Patent no. 5,547,807 (filed Dec. 2, 1994). It claims a "high speed method for presenting display of images obtained from a volumetric scanner in which multiple slices of object space are displayed simultaneously in real time, thereby enabling a viewer to study relationships between various parts of the object." '807 Patent (Abstract). Terms located in claims 1, 2, 3, 4, 19, 20, and 21, have been identified by the parties for construction. The complete text of those claims is as follows:

> 1. An apparatus for simultaneously displaying in real time, an image of at least one section of variable thickness of a three dimensional object having a range of acoustical properties, said at least one cross section being any cross section of said object and selected by a viewer viewing said displayed image, said apparatus comprising:
>
> means adapted for radiating said object with a plurality of sonic beams such that each beam of said plurality of sonic beams generates a wave reflected from a plurality of locations distributed in all regions of said object;

means for resolving said wave into a plurality of echo data, each echo datum of said plurality of echo data representing intensity of reflection of one of said plurality of sonic beams from one of said plurality of locations in said object respectively;

scan converter means for storing each said datum at one of a plurality of addresses in a memory of said scan converter means, each one of said plurality of addresses corresponding to one of said plurality of locations in said object respectively;

means for displaying said image of said at least one section including a screen with a plurality of display locations and terminal means for receiving a plurality of signals and displaying each signal as brightness at a respective one of said plurality of display locations corresponding to said image;

buffer memory means for storing each said echo datum from said scan converter memory then transferring each said echo datum so as to apply a series of said plurality of signals to said terminal means of said display means;

said buffer memory means having buffer memory addresses, each buffer memory address corresponding to one of said display locations respectively;

means operated by said viewer for selecting a set of addresses in said scan converter memory of said scan converter corresponding to said at least one section in said object selected by said viewer;

an address pointer means for matching each buffer memory address to a memory address in said memory of said scan converter means belonging to said set of memory addresses in said scan converter memory and transferring to each said buffer memory address said datum stored in said memory address of said scan converter memory respectively;

means for providing data stored in said buffer memory address to said terminal means of said display means.

2. An apparatus as in claim 1 wherein said means for radiating includes;

means for irradiating an entire volume of said object

by emitting said plurality of beams in a repeated pattern of directions.

3. An apparatus as in claim 2 wherein said radiating means includes means for generating said plurality of beams as groups of beams, each beam in each group having an azimuthal angle advanced over a next previous beam in said each group such that each group produces a B scan having an elevational angle that is advanced over an elevational angle of a next previous B scan such as to produce a volumetric scan.

4. An apparatus as in claim 1 wherein said image has a format selected from a group of formats which consists of I-scans, C-scans and B-scans.

. . . .

19. An apparatus as in claim 1 wherein at least one location of said second plurality of locations in said object is separated from neighboring locations in said object by a distance that is greater than a distance in object space corresponding to two neighboring display locations and said means for resolving comprises means for calculating a hypothetical value of echo datum which is an interpolated value of echo datum computed from echo datum from said at least one location in object space and a neighboring location in object space.

20. An apparatus as in claim 1 wherein at least one location of said second plurality of locations in said object is separated from its neighboring locations in said object by a distance that is smaller than a distance in object space corresponding to two neighboring display locations and said means for resolving said total wave comprises means for calculating a hypothetical value of echo data which is an average value of echo data computer from echo data from said at least one location in object space and at least one neighboring location in object space.

21. A method for simultaneously displaying in real time, an image of at least one cross section of a three dimensional

object having a range of acoustical properties, said at least one cross section being any cross section of said object and selected by a viewer viewing said displayed image, said method including the steps:

(a) radiating said object with a plurality of sonic beams such that one of each said beam generates a total wave reflected from locations in all regions of said object;

(b) resolving said total wave into echo data, each said datum of said echo data representing intensity of reflection of said sonic beam from one of a second plurality of locations in said object respectively;

(c) storing each said datum at one of said second plurality of memory addresses in a scan converter memory, each one of said first plurality of memory addresses corresponding to one of said first plurality of locations in said object respectively;

(d) selecting a set of addresses in said scan converter memory corresponding to said at least one cross section in said object selected by said viewer;

(e) matching buffer memory addresses of a buffer memory to said set of memory address in said scan converter memory;

(f) transferring to each said buffer memory address said datum stored in said scan converter memory address respectively;

(g) sending echo data from said buffer memory to a means for displaying said echo data as brightness on a display screen wherein said coordinates on said display screen correspond to addresses in said buffer memory.

The parties have agreed on the proper construction of the following terms for the '807 patent: "means for resolving said wave into a plurality of echo data," "terminal means," "means adapted for radiating said object with a plurality of sonic beams," "means for displaying said image of said at least one cross section . . . and displaying each signal as brightness at a respective one of said plurality of display locations corresponding to said image," "cross section," "means for irradiating an

entire volume of said object by emitting said plurality of beams in a repeated pattern of directions," "I-scan," "C-scan," "B-scan," and "means for displaying said echo data as brightness on a display screen."[2] Dock. ## 423-1, 435.

The claims to be construed in the '807 patent include claim terms requiring interpretation under general claim construction rules and claims that are amenable to special construction as "means plus function" claims under 35 U.S.C. §112, ¶6 ("means plus function" claims). In addition, Defendants contend that a number of claims - both general and "means plus function" claims - are invalid either because they are either indefinite under 35 U.S.C. §112, ¶2 or because the specification fails to recite adequate structure under 35 U.S.C. §112, ¶6.

A. Terms subject to general rules of claim construction

1. "simultaneously displaying in real time, an image of at least one [cross] section [of variable thickness] of a three dimensional object"

Defendants contend that claims 1 and 21 are invalid because language in the preamble of each is indefinite. Claims 1 and 21 of the '807 patent begin by claiming, in part, an apparatus (claim 1) or method (claim 21) for "simultaneously displaying in real time, an image of at least one [section of variable thickness (claim 1) or cross section (claim 21)] . . . of a three dimensional object." Defendants argue that this language violates 35 U.S.C. §112, ¶2, which requires that the patent applicant distinctly "claim[] the subject matter which the applicant regards as his invention."

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[2] A list of all terms, disputed and undisputed, and their construction is located in chart form at the end of this Memorandum Opinion.

The claim discusses "simultaneously displaying . . . *an* image of *at least one.*" Defendants argue that the term "simultaneously" is an impossible limitation on the claim, because one cannot "simultaneously" display one image.

"Claims need not be plain on their face in order to avoid condemnation for indefiniteness; rather, claims must only be amenable to construction." Wellman, Inc. v. Eastman Chem. Co., 642 F.3d 1355, 1366 (Fed. Cir. 2011) (citing Exxon Research & Eng'g Co. v. United States, 265 F.3d 1371, 1375 (Fed.Cir. 2001)). An accused infringer claiming patent invalidity must "demonstrate by clear and convincing evidence that one of ordinary skill in the relevant art could not discern the boundaries of the claim based on the claim language, the specification, the prosecution history, and the knowledge in the relevant art." Haemonetics, 607 F.3d at 783 (citing Halliburton Energy Servs., Inc. v. M-I LLC, 514 F.3d 1244, 1249 (Fed. Cir. 2008); see also Exxon, 265 F.3d at 1375 ("By finding claims indefinite only if reasonable efforts at claim construction prove futile, we accord respect to the statutory presumption of patent validity . . . and we protect the inventive contribution of patentees, even when the drafting of their patents has been less than ideal.").

The specification provides sufficient information for Claim 1 to be construed as "displaying in real time one image or multiple simultaneous images of at least one section of variable thickness of a three dimensional object." The Court finds that "at least one" encompasses the idea that one image of one section may be displayed in real time, while more than one image of a section may also be displayed

simultaneously in real time. This is consistent with column 4, lines 17-23 of the '807 patent, which contemplates the display of "either one view at a time or multiple simultaneous views" of the object being scanned. Other language in the patent further notes that an object of the invention is to be able to view multiple views and images of an object simultaneously in real time. '807 Patent, col. 3, ll. 5-30. The language "either one view at a time or multiple simultaneous views" shows that the inventors did not intend to leave out the possibility that only one view could be displayed.

The specification provides sufficient information for a reasonable construction so as to preserve the claim's validity. This conclusion is guided by the Federal Circuit's language in Exxon Research Engineering Co. v. United States,, 265 F.3d 1371, 1381-82 (Fed. Cir. 2001):

> Under a broad concept of indefiniteness, all but the clearest claim construction issues could be regarded as giving rise to invalidating indefiniteness in the claims at issue. But we have not adopted that approach to the law of indefiniteness. We have not insisted that claims be plain on their face in order to avoid condemnation for indefiniteness; rather, what we have asked is that the claims be amendable to construction, however difficult that task may be. If a claim is insolubly ambiguous, and no narrowing construction can properly be adopted, we have held the claim indefinite. If the meaning of the claim is discernible, even thought the task may be formidable and the conclusion may be one over which reasonable persons will disagree, we have held the claim sufficiently clear to avoid invalidity on indefiniteness grounds.

Therefore, the relevant language in claim 1 is construed as **"displaying in real time one image or multiple simultaneous images of at least one section of variable thickness of a three dimensional object"** and the relevant language in claim 21 is construed as **"displaying in real time one image or multiple simultaneous images of at least one**

cross section of a three dimensional object."

2. **"real time"**

The Court construes the term "real time" in claims 1 and 21 ("simultaneously displaying in *real time*, an image of . . .) as **"the absence of significant perceptible lag between user selection, acquisition, and display."** Defendant's desired construction, which is "an image is displayed nearly instantaneously in response to user selection of the desired view" does not fully recognize that the image would be displayed in response to near simultaneous acquisition of the image. VMI's desired construction ignores references in the claim language and specification to *displaying* in real time. '807 Patent, col. 10, ll. 59-67. The specification supports a construction that includes acquisition of the image, as the object of the invention is to "present . . . at high speed . . . images simultaneously acquired and displayed". '807 Patent, col. 3, ll. 9-17. The fast display of images is discussed in column 10, lines 59-67 ("The entire display is transformed in 1/30the [sic] of a second"). Column 3, lines 9-17 notes "[t]he arrangement enables the operator to gain a 3-dimensional sense of structural features and to study in real time the relative motion of parts of the object."

The description of a preferred embodiment in the patent states that "each intensity signal and its location . . . is digitized by the beam former and presented in real time to a scan converter," suggesting acquisition and display. '807 Patent, col. 9, ll. 22-25. Other parts of the patent show that the object may be moving, which also suggests fast acquisition and display. '807 Patent, col. 4, ll. 33-36 ("The

arrangement enables the operator to gain a 3-D sense of structural features and to study in real time the relative motion of parts of the object."). Column 3 of the patent notes that an object of the invention includes that the images need to be acquired rapidly enough to show motion of the object without distortion. '807 Patent, col. 3, ll. 53-56 ("It is another object to increase the data acquisition rate and improve image quality of the volumetric scan by the application of transmit mode parallel processing as well as receive mode parallel processing). This describes the rapid display of images as they are being acquired.

Defendants suggest that including the acquisition step ignores the description in the specification which discusses remote review stations. '807 Patent, col. 5, ll. 50-65. To the contrary, this section describes a "further embodiment" which "also provides" for the storing in memory of "all echo data" which "may then be recorded on a removable disk" for future study "at a time and place remote from the patient." Id. The ability to record echo data is in addition to the selection and real time acquisition and display occurring during the scan.

3. "at least one section of variable thickness"

The Court construes the term "at least one section of variable thickness" in claim 1 to mean **"one or more sections having a thickness that may or may not be uniform,"** which is its ordinary meaning. Defendants propose that the term be construed as "one or more sections of user selectable thickness."

The wording of the claim does not support the Defendants' construction.

Specifically, claim 1 claims "[a]n apparatus for displaying in real time, an image of at least one section of variable thickness of a three dimensional object having a range of acoustical properties, said at least one cross section being any cross section of said object and selected by a viewer viewing said displayed image . . . ." The claim itself states that the image or cross section is being selected, not the thickness. The wording of the claim does not support Defendant's construction and thus the ordinary meaning applies.

4. "sonic beam" and "region"

The parties have requested construction of the terms "sonic beam" and "region" in claims 1 and 21(a). Claim 1 describes an apparatus comprising:

> means adapted for radiating said object with a plurality of **sonic beams** such that each beam of said plurality of sonic beams generates a wave reflected from a plurality of locations distributed in all **regions** of said object

Claim 21 describes a method including the steps:

> (a) radiating said object with a plurality of **sonic beams** such that one of each said beam generates a total wave reflected from locations in all **regions** of said object.

'807 Patent (emphasis added). The parties' dispute over the meaning of "sonic beam" and "regions" in claims 1 and 21 requires construction of the relevant parts of claims 1 and 21(a) in their entirety. Defendants contend that claims 1 and 21(a) discuss radiating an entire object with one beam repeatedly, while Plaintiffs contend that claims 1 and 21, when read in the context of the entire patent, describe a system where multiple beams are rapidly transmitted in a pattern of directions.

The Court construes the relevant portion of claim 1 as:

> **means adapted for radiating said object with a plurality of sonic beams distributed in all regions of said object such that each beam of said plurality of sonic beams generates a wave reflected from multiple locations within its path.**

Similarly, claim 21(a) is construed as:

> **radiating said object with a plurality of sonic beams distributed in all regions of said object such that one of each said beam generates a total wave reflected from multiple locations within its path.**

Justification for this interpretation of the claims comes from Column 9, lines 3-23 which describes the process of sending sound and converting it to electrical signals:

> The major parts of the invention are represented in the block diagram of FIG 6. The beam former **16** (signal processor) receives a "total" electrical signal from the array **12** responsive to the reflected wave from object space. The beam former **16** has an array of delays, A/D convertors and adders which resolve the total signal into sets of intensity signals using technology described in U.S. Pat. No. 4,694,434 which has been incorporated by reference into this specification. Conditioning of the delays to generate each intensity signal and association of each intensity signal with the correct location is accomplished by input to the beam former **16** from host controller **76**. Each intensity signal is the signal generated by a reflected wavelet from a set of wavelets. Each set of reflected wavelets originates from a focal region defined by a single transmit beam intersecting a selected cross section. Each wavelet is a reflection of the transmit beam from one of sixteen focal locations in the focal region. More or fewer than sixteen focal locations are included as possible variations.

'807 patent, col. 9, ll. 3-23. Claims 2 and 3 discuss radiating the object with multiple beams in a repeated pattern of directions (claim 2), at varying angles (claim 3):

> 2. An apparatus as in claim 1 wherein said means for radiating includes:
> means for irradiating an entire volume of said object by emitting a plurality of beams in a repeated pattern of directions.

> 3. An apparatus as in claim 2 wherein said radiating means includes a means for generating said plurality of beams as groups of beams, each beam in each group having an azimuthal angle advance over a next previous beam in said each group such that each group produces a B scan having an elevational angle that is advanced over an elevational angle of a next previous B scan such as to produce a volumetric scan.

Claim 10 describes:

> 10. An apparatus as in claim 1 wherein said means for radiating includes:
>
> array means having a radiating surface for radiating said sonic pulsed beam from said radiating surface in any one direction of said first plurality of transmit directions, each transmit direction definable by azimuthal and elevational angular coordinates
>
> means for successively pulsing said array means to emit said first plurality of transmitted beams;
>
> means for controlling each said transmit direction to lie in a repeated *pattern of transmit directions* such as to intersect said object.

'807 Patent (emphasis added). Finally, Column 10, lines 3 and 4 references "[e]cho data from a volume of object space traversed by transmit **beams** during one scan cycle" (emphasis added), indicating that multiple beams are hitting the object. '807 Patent, col. 10, ll. 3-4.

Reading claims 1 and 21 in the context of the specification, it is apparent that one of ordinary skill in the art at the time of the invention would understand that the **sonic beam** described should be construed as **"an acoustic beam that insonifies an object but not necessarily the entire object."** The language in claims 2 and 3 is significant in understanding that the invention involves transmitting a pattern of directional beams that would combine to cover the entire volume of the object. Moreover, column 9, lines 3-23 discuss the reflected wavelets as being within the

transmit beam, indicating that a wave would be reflected from locations in the path of the beam, not from all regions of the object.

In accordance with the construction of claims 1 and 21, "region" is construed as **"a portion of the object,"** consistent with its ordinary meaning. There is no evidence that the drafters of the patent intended for "region" to mean "focal region" or to have any meaning other than the ordinary meaning, nor does the ordinary meaning of "region" deprive the claim of clarity. See, e.g., CCS Fitness, Inc. v. Brunswick Corp., 288 F.3d 1359 (Fed. Cir. 2002) ("[A] claim term will not have its ordinary meaning if the term 'chosen by the patentee so deprive[s] the claim of clarity' as to require resort to the other intrinsic evidence for a definite meaning." (quoting Johnson Worldwide Assocs. v. Zebco Corp., 175 F.3d 985, 988 (Fed Cir. 1999)); K-2 Corp. v. Salomon S.A., 191 F.3d 1356 (Fed. Cir. 1999) ("[I]f the ordinary and accustomed meaning of a disputed term would deprive the claim of clarity, then further reference must be made to the intrinsic – or in some cases – extrinsic evidence to ascertain the proper meaning."). The opinion of VMI's expert, Dr. Walker, is consistent with this interpretation; however, use of his testimony is inappropriate when, as here, the intrinsic record provides sufficient evidence to support the Court's construction.

Defendants have argued that construing claim 1 so that "distributed in all regions of said object" refers to the location of the beams rather than the plurality of locations is rewriting the claim. The claim, as written, however, is not required to be

read so that the "locations" are distributed in all regions, and this construction does not redefine or change the definition of any terms. The claim is amenable to construction, and the specification sheds sufficient light on how a person of skill in the art would read the phrasing in the claim. See, e.g., Exxon, 265 f.3d at 1381-82 ("what we have asked is that the claims be amenable to construction, however difficult that task may be"), Pause Technology, 419 F.3d at 1333 ("[C]ourts cannot 'rewrite' claims. However, in clarifying the meaning of claim terms, courts are free to use words that do not appear in the claim so long as 'the resulting claim interpretation . . . accord[s] with the words chosen by the patentee to stake out the boundary of the claimed property.'" (citation omitted))

5. " storing, matching, and transferring"

Claims 1 and 21 reference "storing," "matching" and "transferring" data. Plaintiffs argue that these terms need not be construed and should be given their ordinary meaning. Defendants contend that the terms should be construed to include *how* the referenced data is stored, matched and transferred. Specifically, Defendants' construction of "storing" is "putting or retaining in a memory unit where each address corresponds to a location on a one-to-one basis." Defendant's construction of "matching" is "mapping each buffer memory address on a one-to-one basis to a corresponding address in the scan converter means." Defendant's construction of "transferring" is "conveying or moving a datum from a unique address location to another location with no modification."

There is no evidence that the patentees intended for "storing", "matching", and "transferring" to be given anything other that than their ordinary meaning. Omega v. Raytek, 334 F.3d 1314, 1325-26 (Fed. Cir. 2003) (stating there must be an unmistakable disclaimer of ordinary meaning). Moreover, it would be improper to read limitations from the specification into the claim. See, e.g., Phillips, 415 F.3d at 132 (stating that it is improper to read limitations from the specifications into the claim).

Therefore, "storing" is construed as **"putting or retaining in a memory unit"**, "matching" is construed as **"causing to correspond to"**, and "transferring" is construed as **"conveying or moving from one place to the other"**.

6. "intensity of reflection"

The Court construes the term "intensity of reflection" to mean the **"strength of the reflected wave."** Citing to ultrasound treatises available at the time of the invention, Defendants argue that "intensity" had a specific meaning at the time of the invention relating to measuring the strength of a sound wave using the power of a wave divided by the area over which the power is spread. Dock. ## 421-5 at 203-04, 421-6 at 28, 333.

The intrinsic record shows that the patentee in this case did not mean for "intensity of reflection" to include the definition of "intensity" used in ultrasound at the time of the invention. In "interpreting an asserted claim, the court should look first to the intrinsic evidence of record, *i.e.* the patent itself, including the claims, the specification, and, if in evidence, the prosecution history." Vitronics, 90 F.3d at 1582.

The words of the claims themselves are to be first considered to determine the meaning of claim terms. Id. In this case, the claims themselves do not give any helpful information regarding the meaning of the term "intensity of reflection" as anything other than the ordinary meaning of the words, nor do they suggest that the scientific term from defendant's ultrasound books should *not* be used. Hoechst Celanese Corp. v. BP Chems. Ltd., 78 F.3d 1575, 1578 (Fed. Cir. 1996) ("A technical term used in a patent document is interpreted as having the meaning it would be given by persons experienced in the field of the invention, unless it is apparent from the patent and the prosecution history that the inventor used the term with a different meaning."); see also Vitronics, 90 F.3d 1576, 1582 (1996) ("Although words in a claim are generally given their ordinary meaning, a patentee may choose to be his own lexicographer and use terms in a manner other than their ordinary meaning, as long as the special definition of the term is clearly stated in the patent specification or file history.")

Next, a court is to review the specification to determine whether the inventor has used any terms in a manner inconsistent with their ordinary meaning. In the context of the terms at issue here, this could be considered in one of two ways: either the ordinary meaning is the colloquial meaning of the word "intensity" used in the phrase "intensity of reflection", and the physics definition is the special meaning, or the physics definition is the ordinary meaning to one skilled in the art and the colloquial meaning is the "special" meaning. Either way, the intrinsic record shows

no intent for "intensity of reflection" to mean anything other than **"the strength of the reflected wave."**

In fact, the specification does indicate that the patentee did not intend for the physics definition of the word "intensity" to be used. Column 9, lines 5-11 of the '807 patent states that "[t]he beam former 16 (signal processor) receives a "total" electrical signal from the array 12 responsive to the reflected wave from object space. The beam former 16 has an array of delays, A/D convertors and adders which resolve the total signal into sets of intensity signals using techniques described in U.S. Pat. No. 4,694,434 which has been incorporated by reference into the specification." Plaintiff's expert, Dr. Walker, who is recognized as one of ordinary skill in the art of ultrasound technology, testified that the structure shown in Figure 12 of the '434 patent does not measure the strength of the received echo in a manner consistent with the physics definition of "intensity." According to Dr. Walker, Figure 12 shows a full wave rectifier and a low pass filter, which combine to determine the amplitude or strength of the received echo.

Defendants point to nothing in the patent to support their construction of "intensity of reflection" and, while the term "intensity" may have had a specific meaning in the ultrasound lexicography at the time the patent was written, VMI has shown that one of ordinary skill in the art at the time of the invention would be able to tell that the patent contradicts that usage and adequately informs the public that the colloquial use of the term "intensity" as it is used in the phrase "intensity of

reflection" applies. Thus, "intensity of reflection" is construed as **"strength of the reflected wave."** This is consistent with the use of the word "intensity" as synonymous with "strength" in the specification where, for example, the following language appears: "[D]istal from the array, the data values are interpolated to estimate echo intensities between locations of data values." '807 Patent, col. 2, ll. 59-61.

7. "said first plurality of memory addresses"/ "said first plurality of locations in said object"

Defendants contend that the terms "first plurality of memory addresses" and "first plurality of locations" in Claim 21 are invalid as indefinite because there is no reference to them in any previous part of the claim or patent. The two phrases are best discussed in the context of Claim 21, through its description of steps a, b, and c:

> 21. A method for simultaneously displaying in real time, an image of at least one cross section of a three dimensional object having a range of acoustical properties, said at least one cross section being any cross section of said object and selected by a viewer viewing said displayed image, said method including the steps:
>
> **(a) radiating said object with a plurality of sonic beams such that one of each said beam generates a total wave reflected from locations in all regions of said object;**
> **(b) resolving said total wave into echo data, each said datum of said echo data representing intensity of reflection of said sonic beam from one of a second plurality of locations in said object respectively;**
> **(c) storing each said datum at one of said second plurality of memory addresses in a scan converter memory, each one of said first plurality of memory addresses corresponding to one of said first plurality of locations in said object respectively;**

'807 patent, col. 18 ll. 40-58 (emphasis added)

Defendants argue that there is no reference to a first plurality of memory addresses or a first plurality of locations anywhere prior to part (c) of the patent. Therefore, according to Defendants, there is no way to construe the claim.

The parties' positions have presented an interesting problem. 35 U.S.C. § 282 gives a patent a statutory presumption of validity. Therefore, a challenger of the patent's validity bears the burden of proving by "clear and convincing evidence" that a patent is invalid. See, e.g., Monsanto Co. v. Scruggs, 459 F.3d 1328, 1336-37 (Fed. Cir. 2006). Moreover, patents are to be construed from the perspective of one of ordinary skill in the art. Defendants' mere argument that the patent does not make sense, with no supporting evidence from the intrinsic or extrinsic record, does not adequately inform whether one of skill in the art would understand the language of the patent. See S3 Inc. v. Nvidia Corp., 259 F.3d 1364, 1371 (Fed. Cir. 2001) (finding there was no contrary evidence to the plaintiff's expert witness and inventor's statements that persons skilled in the field would readily recognize structure not expressly disclosed in the patent and thus invalidity finding was reversed); Xoft, Inc. v. Cytyc Corp., 2007 WL 1241990 (N.D. Cal. 2007) (unpublished) (finding indefiniteness argument "necessarily fail[ed]" because party with burden of proof had offered no evidence suggesting one skilled in the art would not understand meaning of claim).

Plaintiffs' explanation of the patent language, however, also does not

adequately explain what is meant by "first" and "second" "plurality" in this context.

In construing claim terms, "[o]ther claims of the patent in question, both asserted and unasserted, can also be valuable sources of enlightenment as to the meaning of the claim term. . . . Because claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims." Phillips, 415 F.3d at 1314-15 (citations omitted). Claim 23 claims an apparatus that enables a viewer to view a cross section or multiple cross sections of an object. The full text of claim 23 is:

> 23. An apparatus for simultaneously displaying in real time, an image of at least one cross section of a three dimensional object having a range of acoustical properties, said at least one cross section being any cross section of said object selected by a viewer, said apparatus comprising:
>
>> means for producing a first plurality of echo data from a plurality of locations, one datum of said plurality of data from one of said first plurality of locations respectively, said plurality of locations being distributed throughout an entire volume occupied by said object;
>>
>> a memory means having a first plurality of memory addresses for storing each said datum in one of said first plurality of memory addresses respectively, said memory means operably coupled to said means for producing;
>>
>> means for selecting a second plurality of memory addresses from said first plurality of memory addresses, said second plurality of memory addresses having one to one correspondence with a second plurality of locations selected from said first plurality of locations and lying on said at least one cross section;
>>
>> means for displaying said echo data stored in said second addresses as brightness levels on a screen with positions on said screen mapped one to one locations in said second plurality of locations such that said image of said at least one cross section

is displayed on said screen.

In describing what is done in order to view a cross section, claim 23 informs how "first plurality" and "second plurality" represent two types of information being used with respect to the data acquired from the echos received from the object. Claim 23 describes that the "first plurality" describes data received from the entirety of the object volume, and "second plurality" describes data from within that first plurality representing the locations forming the cross section to be viewed. In other words, data in the form of echos are received from locations throughout the entirety of the object volume, and their locations are mapped and contained in the scan converter. When someone wishes to look at a cross section, they can extract the addresses of the second plurality of locations which lie along the cross section.

Reading claim 21 together with claim 23, it is evident that "first plurality" - whether it is a first plurality of locations or memory addresses, refers to locations or memory addresses corresponding to all regions of an object that has been insonified by one or more beams. "Second plurality" refers to locations within the first plurality corresponding to a cross section. Therefore, "first plurality of memory addresses" and "first plurality of locations" are terms which can be construed by reading the entire patent. They are to be construed as follows:

First plurality of locations is construed as **"all locations in an object from which an echo has been received by the beamformer."**

First plurality of memory addresses is construed as **"a set of memory addresses**

corresponding to the first plurality of locations."

Second plurality of locations is construed as **"locations in an object that correspond to a selected cross section of the object."**

Second plurality of memory addresses is construed as **"a set of memory addresses corresponding to the second plurality of locations."**

B. Means-plus-function claims:

1. "means for calculating a hypothetical value of echo [datum (claim 19)/data (claim 20)

The parties agree that "means for calculating a hypothetical value of echo datum" from claim 19 and "means for calculating a hypothetical value of echo data" from claim 20 are subject to interpretation as "means plus function" claims under 35 U.S.C. § 112 ¶6. Defendants contend that claim 19 and 20 are invalid for failure to identify a corresponding structure.

Plaintiff contends that the structure corresponding to "means for calculating a hypothetical value of echo datum" in claim 19 and "means for calculating a hypothetical value of echo data" is, in each claim, a filter. Plaintiff's expert, Dr. Walker, has testified that filters are used for both interpolation and averaging, which are the processes described in claims 19 and 20, respectively. Dock. # 115-1 (Walker Decl. ¶51). In support of its argument that the structure corresponding to "means for calculating" in claims 19 and 20 is "a filter", Plaintiff points to the description of the prior art in column 2, lines 52-64 of the patent, as well as language describing a filter used to interpolate data in column 14, lines 32-51 of the section entitled "Preferred

Embodiment."

Defendants argue that construction of "means for calculating" must take into consideration the language immediately preceding it, which states, as noted in the bolded sections below,

> An apparatus as in claim 1 wherein . . . said **means for resolving comprises** means for calculating a hypothetical value of echo datum which is an interpolated value of echo datum computed from echo datum from said at least one location in object space and a neighboring location in object space.

Similarly, the language at issue from claim 20 reads:

> An apparatus as in claim 1 wherein . . . said **means for resolving said total wave comprises** means for calculating a hypothetical value of echo data which is an average value of echo data computed from echo data from said at least one location in object space and at least one neighboring location in object space.

Defendants argue that there is not a structure in the patent describing an apparatus where a filter (means for calculating) is contained in the "means for resolving." The parties have agreed that a "means for resolving said wave into a plurality of echo data" is a beamformer. The specification and drawings do not disclose an apparatus or system where a filter is contained in the beamformer or where a beamformer "includes" a filter in any way. VMI acknowledges that interpolation takes place in the scan converter. '807 Patent, col. 14, ll 32-51.

Volumetrics attempts to reconcile the language of the claim by saying that the corresponding structure, if the "means for resolving comprises" language is included as part of the structure, is a beamformer plus a filter, and thus interpolation or

averaging takes place in the filter separate from the beamformer.

For purposes of claim construction, as "means for resolving" has already been determined by the parties to be a beamformer, the only structure to be determined is the structure corresponding to "means for calculating" a hypothetical value of echo datum in claim 19 and a hypothetical value of echo data in claim 20. The Court finds the corresponding structure in each claim to be a filter. Whether the filtering is to take place in the beamformer, and the consequent effect of this construction, if any, is for discussion at a later stage of these proceedings. At this time, however, Defendants have not carried their burden to show by clear and convincing evidence that the claim is nonsensical and thus invalid, or that the claim requires that filtering must take place in the beamformer. For claim construction purposes, the patent identifies a corresponding structure in the form of a filter to perform both the interpolation function in claim 19 and the averaging function in claim 20.

Defendants further argue that the additional limiting language in claims 19 and 20, specifying that the value of the echo datum or data is either interpolated or averaged, must be used to determine the function. The Court finds that the additional language is a limitation on the datum and data and is not part of the function. In each case, VMI has shown that it was well known to one of ordinary skill in the art at the time of the patent that a filter is capable of performing either interpolation or averaging. Dock. # 115-1 (Walker Decl. ¶53) ("A filter is used whether one is calculating a hypothetical value of singular echo datum, as in claim 19, or of multiple

echo data, as in claim 20."). Therefore, the function for claim 19 is **"calculating a hypothetical value of echo datum"** and the corresponding structure is **a filter**. The function for claim 20 is **"calculating a hypothetical value of echo data"** and the corresponding structure is **a filter.**

2. "means for generating said plurality of beams as groups of beams"

Defendants also claim there is no corresponding structure for the "means for generating" described in claim 3. Claim 3 recites, in relevant part:

> An apparatus as in claim 2 wherein said radiating means includes **means for generating said plurality of beams as groups of beams,** each beam in each group having an azimuthal angle advanced over a next previous beam in said each group *such that each group produces a B scan having an elevational angle that is advanced over an elevational angle of a next previous B scan such as to produce a volumetric scan*.

'807 patent, col. 16, ll. 6-13 (emphases added).

Plaintiff's construction is that the claimed function is a "means for generating said plurality of beams as groups of beams" and the corresponding structure is a transducer. Volumetrics has presented evidence that, at the time, it was well understood by one of ordinary skill in the art that the structure that generates beams is the transducer, and that a transducer may be configured to generate a plurality of beams as groups of beams:

> The transducer array disclosed in the invention [at Col. 5, ll. 15-22] can be readily utilized to steer beams in azimuth by applying relative delays to the signals emitted by (for transmission) or received by (for reception) elements of the transducer array. This 'phased array' beamsteering operation is well known to those of ordinary skill in the art. The patent discloses the use of phased array beamsteering when it refers to the present invention as a 'phased array volumetric scanner.' See '807

> patent, 10:7. To one of ordinary skill in the art it is readily apparent that the application of steering delays is adequate to interrogate a plurality of azimuthal orientations. Such a grouping of beams generates a B scan.

Dock. # 115-1 (Walker Decl. ¶ 47).

Defendants argue that the claimed function includes all of the language following "means for generating," and, if the claimed function includes the specific requirements regarding groups of beams in a phased beamsteering operation, specific structure has not been disclosed to perform the specific function.

Volumetrics argues that the language underlined in claim 3, above, is not part of the function because it describes a result of the function. Citing Lockheed Martin Corp. v. Space Systems/Loral, Inc., 324 F.3d 1308 (Fed. Cir. 2003), Volumetrics argues that the underlined language describes a separate limitation on the type of beam and then describes a result of the function ("such that each group produces a B scan. . . "). Lockheed, 324 F.3d at 1319 (citing Texas Instr., Inc. v. United States Int'l Trade Comm'n, 988 F.2d 1165, 1172 (Fed. Cir. 1993) ("The function is properly identified as the language after the "means for" clause and before the "whereby" clause, because a whereby clause that merely states the result of the limitations in the claim adds nothing to the substance of the claim.").

The Court construes the function to be "**generating said plurality of beams as groups of beams, each beam in each group having an azimuthal angle advanced over a next previous beam in said each group.**" The remainder of the claim language does state the result of the function, which is to produce a B scan. The Court finds that the

underlined language is necessary to convey the type of transducer required to transmit the groups of beams in a particular way. Therefore, the corresponding structure is a **phased array transducer.**

3. "scan converter means," "buffer memory means," and "address pointer means"

The parties seek construction of three terms in claim 1 which include the word "means" but which VMI contends are not subject to interpretation under 35 U.S.C. §112, ¶6. VMI contends that the presumption that the claims are in means-plus-function format is overcome because the terms "scan converter means", "buffer memory means", and "address pointer means" recite structures that have a reasonably well understood meaning in the art. See, e.g., Cole, 102 F.3d at 531 ("To invoke this statute, the alleged means-plus-function claim element must not recite a definite structure which performs the described function."); see also Intel Corp. v. Broadcam Corp., 172 F.Supp.2d 515, 548 (D. Del. 2001) ("In determining whether the claim language recites a structural term . . . the court should read the claim language in light of both the specification and prosecution history [and] examine whether the claim element at issue has a well-understood meaning in the art."); Envirco Corp. v. Clestra Cleanroom, Inc., 209 F.3d 1360, 1365 (Fed. Cir. 2000) (finding that the term "baffle" itself was a structural term and "its use in the claims rebuts the presumption that §112, ¶6 applies"). In each case, Defendants argue that the structure recited in the claim is not sufficient to perform the stated function.

"scan converter means"

Claim 1 includes a "scan converter means for storing each said datum at one of a plurality of addresses in a memory of said scan converter means." Defendants argue that the claim does not recite sufficient structure because the "memory" part of the function must include a host controller. The patent specification contains numerous discussions indicating that the host controller controls the format of the data to the scan converter and communicates with the scan converter regarding the format of the data; however, the "prior art" section of the '807 patent refers to a frame buffer memory in the scan converter. '807 Patent, col. 2, ll. 32-34 ("The scan converter includes a frame buffer memory wherein each address is identified by u,v, the coordinates of the corresponding location on the display screen."). Moreover, VMI presented Dr. Walker's testimony that scan converters were well known at the time of the invention. Dock. # 115-1 (Walker Decl. ¶39). As scan converters were known in the prior art to perform the function cited in the claim, the term "scan converter" recites sufficient structure to perform the described function. Therefore, "scan converter means" is construed as a **scan converter.**

"buffer memory means"

Claim 1 also includes a "buffer memory means for storing each said echo datum from such said scan converter memory then transferring each said echo datum so as to apply a series of said plurality of signals to said terminal means of said display means." Plaintiff contends that this claim also is not in means-plus-function format because sufficient structure is recited in the claim itself so that a person of ordinary

skill in the art would understand that a "buffer memory means" is simply a "buffer memory."

Defendants contend that the term is in "means plus function" format because it claims both storing and transferring functions and the claim itself does not recite sufficient structure to accomplish both storing and transferring. Column 2 of the patent, which is part of the patent that describes the prior art, states at line 31 that "the scan converter includes a frame buffer memory wherein each address is identified by u, v, the coordinates of the corresponding location on the display screen." '807 Patent, col. 2, ll. 1-8 (emphasis added). Also Column 5 of the patent, summarizing the invention, states at lines 1-8:

> In practice, the reflected ultrasound intensity at each location in the selected slice is projected electronically onto the display plane by storing the echo data in an echo data memory having addresses corresponding to locations on the slice expressed in the coordinates R,ϕ,θ and then transforming the echo data into a frame buffer memory having addresses corresponding to the u, v coordinates of the display screen.

'807 Patent, col. 5, ll. 1-8. Other references to the buffer memory as a structure are made at column 10, ll. 3-30.

According to VMI's expert, Dr. Walker, the term "buffer memory" is a structural term "well understood to those of ordinary skill in the art" to be a temporary storage location. "A frame buffer that stores image date for display during a subsequent frame is one example of a buffer memory." Dock. # 115-1 (Walker Decl. ¶ 42). As such, one of skill in the art would "appreciate that for . . . any practical buffer memory to be used, it has to not only store data, but it must also output that data,

thereby transferring the data so a buffer memory intrinsically incorporates the function of transferring." Dock. # 366, Tr. at 472.

VMI also presented evidence that Figure 9 references buffers and buffer memories where data is transferred out. Dock. # 366 (Markman Hr'g Tr. 472, May 21, 2008). Dr. Walker also explained that "[b]uffer memories have outputs . . . It is transferring the data and may be told to transfer now or transfer forever, but it is doing the transferring. It has electronics at its output to push those signals out into the world, to transfer them, if you will." Id. at 473-474.

In summary, the patent indicates that buffer memories were already known in the art at the time of the invention. The additional explanation by Dr. Walker, as one of skill in the art at the time of the invention, that buffer memories are temporary storage locations and that output is inherent in the frame buffer memory, leads to the Court's conclusion that Claim 1 recites sufficient structure to overcome the presumption that it was drafted in means plus function format. Therefore, "buffer memory means" is construed simply as a **"buffer memory."**

"address pointer means"

Claim 1 includes an "address pointer means for matching each buffer memory address to a memory address in said memory of said scan converter means belonging to said set of memory addresses in said scan converter memory and transferring to each said buffer memory address said datum stored in said memory address of said scan converter memory respectively." VMI presented evidence from Dr. Walker that

an address pointer is a structural term "well understood to those of ordinary skill in the art" to be "hardware or software that locates an address in memory." "Such pointers are commonly used in computer programming, where a variable holds the location of a piece of data in memory, rather than holding the piece of information itself." Dock. # 115-1 (Walker Decl. ¶ 44).

Defendants argue that an address pointer does not perform the functions of matching and transferring and thus the term "address pointer" does not recite adequate structure to overcome the presumption that the claim is in means plus function format. Although an address pointer may be well known to a person of ordinary skill in the art, the claim recites a function that has not been identified by VMI's expert to be included in the function of an address pointer. Thus, VMI has not presented sufficient evidence to show that the claim itself recites sufficient structure to perform the function in order to overcome the presumption that it is in means-plus-function format.

Both parties do acknowledge that the Output Address Register 28 in Figure 9, which is connected between scan buffer memories 26A and 26B and video frame buffers 30A and 30B, as well as the data paths between the scan converter memories and video frame buffers (shown in FIG. 9 between 26A and B and 30A and B and detailed in FIG. 11) are the structures recited in the specification that correspond to the function recited in the claim. The specification discusses the recited function and structure in numerous places in the specification and specifically provides for matching

and transferring at column 5, lines 22 to 31 and column 9, lines 33-45.[3] Therefore, the claim will be construed in means plus function format. The function is "**matching each buffer memory address to a memory address in the memory of the scan converter belonging to the set of memory addresses in the scan converter memory and transferring to each buffer memory address the datum stored in the memory address of the scan converter memory respectively**" and the structure is "**Output Address Generator 28 and data paths shown in FIG 9 between 26A and B and 30A and B.**"

---

[3] Defendants also reference column 12, line 54 to column 13, line 44. As noted in column 13, lines 43-45, that section of the patent discusses the generation of output addresses which are "used by the Scan Data Buffer to pass the echo data to the Video Output Buffer." The Scan Data Buffer is shown in FIG 9 as the "Scan Buffer Memory 26A and 26B". (See Col. 11, l. 67). The Video Output Buffer is shown in FIG 9 as "Video Frame Buffer 30A and 30B" and is discussed in column 14, ll. 3-20 (entitled "1/2 Mbyte Video Output frame buffer memory 30A, B"). The discussion in columns 12 and 13 referenced by Defendants appears to center around the matching function; however, neither party provided any further analysis by a person skilled in the art regarding what exactly was being referenced in that section of the patent. A large part of the discussion centers around what is received from the Host Controller and what the Host Controller then transfers to the Scan Converter. Column 13, lines 15- 44 goes on to describe paths in the Output Address Generator which facilitate generating the addresses which are ultimately transferred to the Video Output Buffer. Defendants argue that the detailed paths shown in FIG. 11 need to be included as part of the Output Address Generator. These detailed structures will not be included for two reasons. First, Defendants have not provided enough evidence regarding the function of those structures to include them. Second, it is doubtful such detail in the structure is necessary to properly identify the structure in the claim.

4. **"means operated by said viewer for selecting a set of addresses in said scan converter memory of said scan converter corresponding to said at least one section in said object selected by said viewer"**

Claim 1 includes a "means operated by said viewer for selecting a set of addresses in said scan converter memory of said scan converter corresponding to said at least one section in said object selected by said viewer." The parties agree that the above language of claim 1 should be construed in means plus function format, and that the function is **"selecting a set of addresses in the scan converter memory of the scan converter corresponding to the at least one section in the object selected by the viewer."** Dock. # 423-3.

The parties disagree regarding the corresponding structure. VMI contends that the language "operated by said viewer" requires that only the track ball, light pen or mouse be included as structure. Defendants contend that selection cannot be accomplished without the use of additional structures, identified as:

> [o]perator controlled device 33 such as a track ball or light pen, display 34, host controller 76 programmed with an algorithm for providing pyramidal icon 17 and obtaining a user selection of display slices from that pyramidal icon, as described at col. 5, ll. 32-38, col. 5, ll. 66-col. 6, l. 2, col. 7, ll. 1-4, col. 7, l. 56-col. 8, l. 32, col. 10, ll 61-67, and shown in Figs 3B and 6.

Dock. # 423-3. Column 5, lines 32 to 38 of the '807 Patent discusses slice selection:

> The slice [sic] are selected by the operator using a track ball or light pen to modify a pyramidal icon which is shown continually on the display screen. . . . The operator controlled select device is interfaced to the Host Digital Controller and Scan Converter.

'807 Patent, Col. 5, ll. 32-38 (emphasis added). Column 7 also discusses slice

selection:

> An icon **17** is also shown which is activated by a track ball to select the slices. The icon **17** is a pyramid with which parameters associated with the selection of the slice are positioned along the edge of the pyramid.
>
> * * *
>
> Slice selection is carried out *by the operator* using a pointer such as the operator controlled select device (not shown) of the host controller 76 of FIG 6 combined with the pyramidal icon 17 in the display of FIG 3B. Under interactive software using the light pen or track ball *the operator* indicates three points on the display screen icon 17 such as points u,v,w on slice C-1 in FIG 3G. The three points in the icon 17 correspond to three points in the pyramidal scan volume. . . .

'807 Patent, col. 7, ll. 1-4, 57-65 (emphases added). Thus, as the underlined language above shows, the patent language discussed the operator's participation in selection in slice selection in conjunction with the select device as well as additional structures, including a pyramidal icon, display, host controller and interactive software.

The Federal Circuit has noted that, while "corresponding structure need not include all things necessary to enable the claimed invention to work . . . [c]orresponding structure must include all structure that actually performs the recited function." Cardiac Pacemakers, Inc. v. St. Jude Med., Inc., 296 F.3d 1106, 1119 (Fed. Cir. 2002); Engineered Prods. Co. v. Donaldson Co., Inc., 147 Fed. Appx. 979, 984 (Fed. Cir. 2005) (finding district court's "button" structure too broad to perform function of "selectively disengaging the interengagable notches so as to permit the diaphragm to return to its infold position when the vacuum in the first chamber is

relatively low" because the "specification . . . clearly links the button, flange, bottom wall, and enlarged opening to the function of disengaging the interengagable notches"). The function agreed upon by the parties is "selecting a set of addresses . . . corresponding to the at least one section in the object." Accomplishing this requires more structure than merely the track ball, light pen or mouse.

In Engineered Products, the Federal Circuit explained why a button alone was not enough to "selectively disengage the interengageable notches": "It is true that an individual initiates the process of disengaging the notches by pushing the button located at the bottom of the chamber. However, it is the resulting action of the flange against the bottom wall that actually causes the interengagable notches to disengage." Id. at 984. Similarly, here, the individual's use of a track ball, light pen, or mouse initiates the process of selecting the slices, but it is the interaction of the track ball, light pen or mouse with the pyramidal icon, interactive software and display that actually results in the selection of addresses corresponding to a section of the object.

The pyramidal icon interacts with software programmed to take user input and convert it into the addresses for the slices. '807 Patent, col. 7, ll. 56 - col. 8, ll. 32. The algorithm associated with that aspect of selecting a slice is described in the specification through the "well known principle of three dimensional analytic geometry." Id.; see, e.g., Typhoon Touch Techs, Inc. v. Dell, Inc., 659 F.3d 1376, 1386 (Fed. Cir. 2011) (quoting Finisar Corp. v. DirecTV Group, Inc., 523 F.3d 1323

(Fed. Cir. 2008) ("Precedent and practice permit a patentee to express [a] procedural algorithm 'in any understandable terms including as a mathematical formula, in prose, or as a flow chart, or in any other manner that provides a structure.'").

The recited function includes selecting addresses corresponding to at least one cross section of the object selected by a viewer. A track ball, light pen or mouse cannot select addresses without the corresponding icon, interactive software, and display. As noted above, the specification clearly links these structures to slice selection. Thus, the structures that perform the recited function are **"an operator controlled device such as a track ball, light pen or mouse combined with the pyramidal icon 17; display 34; host controller 76; and interactive software programmed with an algorithm for providing pyramidal icon 17 and obtaining a user selection of display slices from that pyramidal icon as described in col. 7, ll. 56-col. 8, ll. 32 and FIG. 3B."**

5. "means for providing data stored in said buffer memory address to said terminal means of said display means"

The parties agree that the language in claim 1 which includes "means for providing data stored in said buffer memory address to said terminal means of said display means" is in means-plus-function format. The Court finds that the function is **"providing data stored in said buffer memory address to the terminal of the display"**.

The parties have agreed that "terminal means" is simply "a terminal" and "display means" is a display. Thus, the functional language has been simplified to reference those structures. Defendants argue that the structure corresponding to "providing data stored in said buffer memory address to the terminal of the display"

should be "the data path shown in Figure 9 between video frame 30A and 30B of display 34" because it describes to which data path the claim refers. VMI's corresponding structure is the more general description of "a data path from the buffer memory to the terminal of the display." VMI's corresponding structure is not described in the specification anywhere other than as it is shown in FIG. 9. In using means-plus-function language, VMI is limited to the described structure and its equivalents. Therefore, the associated structure is **"the data path shown in Figure 9 between video frame 30A and 30B of display 34."**

III. Claim Construction for the '211 Patent

The '211 patent claims the method of scanning a volume based on a selected configuration of slices, thus "reducing the time needed to provide a view of the selected slice compared to conventional systems." '211 Patent Abstract. The '211 patent is asserted only against Defendant Siemens and requires construction of five terms, located in claims 3 and 18. The complete text of claims 3 and 18 is as follows:

> 3. A method of scanning a volume in body using ultrasound beams, the method comprising the steps of:
> selecting at least one slice of the volume;
> scanning a first portion of the volume defined by the at least one slice that is
> less than the volume at a scan rate that is based on a ratio of a volume of the first portion to the volume by eliminating scanning of a second portion of the volume that is separate from the first portion; and
> wherein the step of scanning comprises the steps of:
> transmitting a plurality of transmit ultrasound beams downstream from an ultrasound transducer through the at

least one slice of the volume to a scan range of the volume, wherein the at least one slice is located upstream in the volume from the scan range; and

tracking the plurality of transmit ultrasound beams downstream from the ultrasound transducer through the first portion of the volume to form a plurality of ultrasound scan lines until the plurality of transmit ultrasound beams reach respective locations in the at least one slice.

18. A system that scans a volume in a body using ultrasound beams, the system comprising:

means for selecting at least one slice of the volume;

means for scanning a first portion of the volume defined by the at least one slice that is less than the volume at a scan rate that is based on a ratio of a volume of the first portion to the volume by eliminating scanning of a second portion of the volume that is separate from the first portion; and

wherein the means for scanning comprises:

means for transmitting a plurality of transmit ultrasound beams downstream from an ultrasound transducer through the at least one slice of the volume to a scan range of the volume, wherein the at least one slice is located upstream in the volume from the scan range; and

means for tracking the plurality of transmit ultrasound beams downstream from the ultrasound transducer through the first portion of the volume to form a plurality of ultrasound scan lines until the plurality of transmit ultrasound beams reach respective locations in the at least one slice.

Additionally, the parties agree to the construction of these claim terms: "scanning", "tracking", "portion", "scan rate", "ultrasound scan line", and "slice."[4] As with the '807 Patent, the '211 patent requires use of general claim construction rules and the rules of construction applicable to claims drafted in accordance with 35

[4] A list of all '211 terms, disputed and undisputed, and their constructions is located in chart form at the end of this Memorandum Opinion.

U.S.C. §112.

A. "scan range"

The Court construes the term "scan range" as found in claims 3 and 18 as **"a distance from the transducer sufficient to encompass – i.e. envelop – the slice or slices selected"**. Claims 3 and 18 require that the ultrasound beams be transmitted "downstream . . . through the at least one slice of the volume . . . to a scan range of the volume." The only requirements in the claim are that the scan range is downstream of the selected slice and that the scan range is within the volume. The claim does not require that the scan range be the maximum distance from the transducer, as argued by VMI, or a set distance, as argued by Siemens. The Court's construction also does not foreclose the idea that a scan range may be set by the user.

Siemens's construction, which is "the constant distance from the transducer face to the depth of the volume" contemplates that the scan range is always to the depth of the volume, and that the range is constant. Neither limitation is part of the claim itself, and they are only presumed limitations based on the Defendant's interpretation of the drawings. The claim and specifications suggest only that the scan range is a range beyond the selected slice. The drawings show the scan range may be at the end of the volume, but the patent does not require that the range go to the depth of the volume each time.

Similarly, VMI's proposed definition, "maximum scan distance from the

tranducer," suggests a limitation that does not appear in the claim or specification. The only requirement in the claim relating to the distance of the scan range is that it be beyond the slice. How far beyond, or how far the range is in relation to the transducer, are not limitations given in the claim or specification.

Therefore, as noted above, the "scan range" is **"a distance from the transducer sufficient to encompass – i.e. envelop – the slice or slices selected"**.

B. Means-plus-function claims

The parties agree that the remaining terms to be construed by the Court in the '211 patent are in claim 18 and are subject to interpretation under 35 U.S.C. § 112 ¶ 6. Claim 18 discusses the structures associated with selecting a slice and scanning the volume up to that slice to create a 3D ultrasound image.

1. "means for selecting at least one slice of the volume"

The parties agree that the function associated with the phrase "means for selecting at least one slice of the volume" is **"selecting at least one slice of the volume."** Dock. #421, Ex. B. They disagree as to the corresponding structure. VMI's proposed structure consists only of "a user interface such as a track ball, light pen, mouse, tablet or keyboard." Siemens's structure is far more inclusive, consisting of:

> a user interface 555 (either a track ball, light pen, mouse, tablet, or keyboard), display 570, which may be either a cathode ray tube (CRT) or a liquid crystal display (LCD), and processor 550, which may be a computer such as an engineering workstation or a personal computer or a processor dedicated to controlling the overall operation of the 3D ultrasound imaging system, connected to the user interface and the display, programmed with an algorithm for obtaining user input selecting

a configuration including I slices and/or C slices from a plurality of configurations and determining the locations of the selected slices in the volume based upon the selected configuration, as described at col. 3, ll. 38-44, col. 5, ll. 46-57, col. 5, ll. 65-col. 6, l. 2, col. 6, ll. 2-4, col. 6, ll. 59-63, col. 7, ll. 49-51, and col. 10, ll. 40-47, and shown in Figs 5 and 9C (the portions of figure 9C and related description that refer to B slices, operations 904, 906, and part of 916, are not relevant to this claim).

Dock. # 421, Ex. D. As noted with respect to slice selection in the '807 patent, the structure associated with slice selection requires more than just the user interface. Engaging a track ball, light pen, mouse, tablet or keyboard alone will not accomplish the function of slice selection; rather, the interaction of several structures is required. Cardiac Pacemakers, 296 F.3d at 1119; Engineered Prods. Co. v. Donaldson Co., Inc., 147 Fed. Appx. 979, 984 (Fed. Cir. 2005).

The specification in the '211 patent reveals that the user interface, display, and the processor are structures linked to slice selection. The patent clearly links the user interface with slice selection in several places. '211 Patent, col. 3, ll. 40-41 ("For example, a user may select the slices to be viewed via a user interface."); col. 5, ll. 50-54 ("The slice is selected using an interface 555 connected to the processor 550. For example, the user may select 3 points in the volume 540 that corresponds to the selected slice 545."); col. 7, ll. 49-50 ("According to Fig. 8, the C slice 801 and the first and second B slices 802, 803 are selected for viewing via the user interface.").

In order to select a slice using the user interface, however, the user must be able to see what is being selected on the display. In this regard, the display is not

merely enabling the function of selection, as VMI argues. One cannot select "at least one slice of the volume" without being able to view what is being selected. The function of selection could not occur if the display structure were not present. Cf. Cardiac Pacemakers, 296 F.3d at 1116 (noting timer structure could "not properly be considered structure corresponding to the activating means" because "[t]his activation would occur even if the timer were not present").

While the display structure in the '211 patent is primarily linked to displaying the selected slice on the screen after it has been selected and scanned, the specification links it to slice selection in column 5, lines 8-15:

> A user selects a configuration of slices of the volume 540 to be scanned and viewed on a display 570 from a plurality of configurations.
>
> The display 570 may comprise a Cathode Ray Tube (CRT), Liquid Crystal Display (LCD) or other display known to those having skill in the art. The plurality of configurations includes B slices, I slices, and C slices and combinations thereof. The volume 540 is *then scanned* based on the configuration of slices selected by the user).

'211 Patent, col. 5, ll. 8-15 (emphasis added). Looking at the structure of the paragraph, one can determine that the more detailed description of the display is discussed prior to a discussion regarding the slice configurations to be chosen and scanned, indicating that the display may be used in connection with the selection of the configuration of slices to be scanned. Selection is also discussed at length in the '807 patent, which discusses the display in

connection with selecting a slice and is incorporated by reference in the '211 patent. '211 Patent, col. 1, ll. 53-62; '807 patent, <u>see infra</u> §II.B.4.

The processor is also linked to slice selection in several places:

> In another aspect of the present invention, the slices are selected before the transmit ultrasound beams are transmitted into the volume. For example, a user may select the slices to be viewed via a user interface. *A processor determines the location of the selected slices in the volume.*
>
> '211 Patent, col. 3, ll. 38-44. (emphasis added).

In column 5 of the '211 patent the processor is referenced again with respect to slice selection: "The slice **545** is selected using an interface **555** *connected to the processor 550*. For example, the user may select 3 points in the volume **540** that corresponds to the selected slice **545**." '211 Patent, col. 5, ll. 50-53.

Thus, the processor interacts with the interface to complete slice selection before the volume can be scanned. Because the disclosed structure includes a processor programmed to determine the location of slices in the volume, an algorithm or equation for obtaining user input in selecting a configuration is necessary. <u>See</u> <u>WMS Gaming, Inc. v. Internat'l Game Tech.</u>, 184 F.3d 1339, 1349 (Fed. Cir. 1999) ("In a means-plus-function claim in which the disclosed structure is a computer, or microprocessor, programmed to carry out an algorithm, the disclosed structure is not the general purpose computer, but rather the special purpose computer programmed to perform the disclosed algorithm.). Column 9 gives an example of how slices may be identified from points in the volume prior to scanning, stating that three points

selected by the user may be expressed as Cartesian coordinates of the selected planes in the volume. The coefficients are derived "using mathematical techniques known to those of skill in the art." '211 Patent, col. 9, ll 39-54; see also Typhoon Touch, 659 F.3d at 1376, 1384 ("The usage 'algorithm' in computer systems has broad meaning, for it encompasses 'in essence a series of instructions for the computer to follow, whether in mathematical formula, or word description of a procedure to be implemented by a suitably programmed computer.'" (citation omitted))[5]

Finally, Siemens suggests that only I or C slices are relevant to the structure associated with the function of "selecting at least one slice in the volume." No such limitation exists in the claim language or the specification. First, the parties have agreed to the construction of the term slice, which is a "section made by a plane cutting anything transversely." That definition does not exclude B slices, nor does the wording of claim 18. "B" slices may be selected and scanned to a scan range, with tracking occurring up to the selected slice.

Therefore, the structure associated with **"selecting at least one slice of the volume"** is: **a user interface 555 (either a track ball, light pen, mouse, tablet, or**

[5] Siemens suggests the algorithm in Fig. 9C is required to use the processor for the purpose of selecting a slice in the volume. The processor's function in selecting, however, relates to determining the location of the slices in the volume. The algorithm in 9C relates to controlling the beamformer in accordance with the selected slice configuration. Moreover, Fig. 9C is referenced in the specification as illustrating the "operations of a 3D ultrasound imaging system according to the present invention." '211 Patent, col. 11, ll. 18-20.

keyboard), display 570, which may be either a cathode ray tube (CRT) or a liquid crystal display (LCD), and processor 550. The processor 550 may be a computer such as an engineering workstation or a personal computer or a processor programmed with an algorithm for obtaining user input selecting a configuration of slices from a plurality of configurations and determining the locations of the selected slices in the volume based upon the selected configuration, as described at col. 9, ll. 14-54.

2. **"means for transmitting", "means for tracking", "means for scanning"**

The final three terms to be construed in the '211 patent are in claim 18 and are written in means-plus-function format. As the "means for scanning" "comprises" the "means for transmitting" and the "means for tracking", scanning will be discussed last.

"means for transmitting"

The parties agree that the "means for transmitting" in claim 18 has the function of **"transmitting a plurality of transmit ultrasound beams downstream from an ultrasound transducer through the at least one slice of the volume to a scan range of the volume."**

VMI's proposed structure corresponding to the transmitting function is simply a transducer. Siemens argues that several other structures are required for the transmitting function, including, though in more specific terms, the transducer, beamformer, and processor "dedicated to controlling the overall operation of the 3D

ultrasound imaging system and programmed with an algorithm for controlling the beamformer 500."

Siemens also contends that a specific "transducer 520 comprised of a two-dimensional array of 256 ultrasound transducer elements arranged as an array of independently excitable 16x16 ultrasound transducer elements" is required by the patent. The number of elements and the way in which they are arranged in the transducer are not required by the language of the claim or the function. The patent repeatedly discusses transmitting beams "from an ultrasound transducer." '211 Patent, col. 3, ll. 15-18, ll. 25-28; col. 5, ll. 28-31; col. 6, ll. 48-52; col. 7, ll. 2-5, 23-27, col. 7, ll. 51-53. In its discussion of a preferred embodiment, the specification states that "the transducer 520 *may comprise* 256 ultrasound transducer elements arranged as an array of 16x16 ultrasound transducer elements that may be independently excited." '211 Patent, col. 5, ll. 32-35. The specification does not state that such a specific type of transducer is required. Moreover, since the specification consistently refers to the more generic transducer as the structure linked to transmitting, including the specific transducer as it is one example of a structure is redundant, as it is one example of a transducer within the broader category of transducers linked to the transmission function. See Micro Chem., Inc. v. Great Plains Chem. Co., Inc., 194 F.3d 1250, 1258-59 (Fed. Cir. 1999) ("When multiple embodiments in the specification correspond to the claimed function, proper application of §112, ¶6 generally reads the claim element to embrace each of these

embodiments.").

Siemens argues that the beamformer and processor are also structures linked in the specification to the function of transmitting. The beamformer and processor generally do not appear to have a role in the actual transmission of beams. Rather, in most of the '211 patent the beamformer is the structure which forms the beams prior to transmission and the processor has a role in the tracking and scanning functions. '211 Patent, col. 5, ll. 35-39 ("The transmit ultrasound beams are formed by exciting selected ultrasound transducer elements of the ultrasound transducer 520 at predetermined times under the control of the beamformer 500 according to techniques known to those of skill in the art."); col. 8, ll. 32-35 ("The beamformer 500 generates electrical signals which produce the plurality of transmit ultrasound beams 530a, 530b, 530c from the ultrasound transducer 520, to insonify the volume 540."); col. 10, ll. 58-61 ("The beamformer 500 provides excitations to the ultrasound transducer to steer the transmit ultrasound beams in the volume to scan the selected B slices of the volume.").

In one alternate embodiment, however, where B slices are selected, the "processor 550 controls the beamformer 500 so that the transmit ultrasound beams are transmitted until the B slices in the configuration selected by the user are defined, whereupon no other transmit ultrasound beams are transmitted for the present scan." '211 Patent, col. 9, ll. 8-13. Thus, transmitting, rather than tracking, is stopped by the beamformer and processor in the case of a B slice. Therefore, the processor and

beamformer are included structures, along with the transducer, for the function of "transmitting a plurality of transmit ultrasound beams through the at least one slice of the volume to a scan range of the volume." See, e.g., Micro Chem., 194 F.3d at 1258-59 ("When multiple embodiments in the specification correspond to the claimed function, proper application of §112, ¶6 generally reads the claim element to embrace each of those embodiments.").

Because the processor is included, the algorithm associated with controlling the beamformer is also an associated structure. A discussion of the algorithm is found in column 11, line 18 to column 12, line 15, and is presented as a flow chart in FIG. 9C.

Siemens further argues that B slices must be excluded from the description of the structure discussion of the structure because the function of "transmitting . . . through the at least one slice of the volume to a scan range of the volume" is not the same as the language in the alternative embodiment where the "processor 550 controls the beamformer 500 so that the transmit ultrasound beams are transmitted until the B slices in the configuration selected by the user are defined, whereupon no other transmit ultrasound beams are transmitted for the present scan." '211 Patent, col. 9.

Claim 18 does not limit transmission of beams for only I and C slices. Furthermore, the language above from column 9 is not limited by the language of claim 18. Nothing in the alternative embodiment of Figure 7 forecloses the possibility that a beam would be transmitted to a scan range which also signified the end of a

B slice, where the processor would stop transmitting beams.

Therefore, the corresponding structures for the function of "transmitting a plurality of transmit ultrasound beams downstream from an ultrasound transducer through the at least one slice of the volume to a scan range of the volume" are **an ultrasound transducer, beamformer 500, and processor 550, which may be a computer workstation or a personal computer or a processor dedicated to controlling the overall operation of the 3D ultrasound imaging system and programmed with an algorithm for controlling the beamformer 500 as described in column 9, l. 29-col. 10, l. 50, col. 11, line 18 to column 12, line 15, and in FIG. 9C.**

"means for tracking"

Claim 18 also includes a "means for tracking the plurality of transmit ultrasound beams from the ultrasound transducer through the first portion of the volume to form a plurality of ultrasound scan lines until the plurality of transmit ultrasound beams reach respective locations in the at least one slice." '211 Patent, col. 14, ll. 33-38. The parties dispute the function and the structure.

VMI argues that the function should be limited to "tracking the plurality of transmit ultrasound beams from the ultrasound transducer through the first portion of the volume" and that the remainder of the claim language is a result of the function that should not be included. The remaining language in claim 18, however, is not a result of the function. It is a limitation in the claim that must included. See, e.g., Lockheed Martin, 324 F.3d at 1319 (stating that the function may not be "improperly

broadened by ignoring the clear limitations contained in the claim language" and that the "function of a means-plus-function claim must be construed to include the limitations contained in the claim language"). Thus, the tracking function in claim 18 is **"tracking the plurality of transmit ultrasound beams downstream from the ultrasound transducer through the first portion of the volume to form a plurality of ultrasound scan lines until the plurality of transmit ultrasound beams reach respective locations in the at least one slice."**

VMI contends that the associated structure is simply a beamformer. Siemens again includes a far more detailed structure which includes, though in more specific terms, the transducer, beamformer, memory, address generator and processor programmed with an algorithm for controlling the beamformer.

The patent specifically defines "tracking" as "the use of parallel receive processing to form ultrasound scan lines from the transmit ultrasound beams transmitted into the volume." '211 Patent, col. 4, ll. 47-50. The scan lines make up a 3D data set "that represents the volume of tissue through which the transmit ultrasound beams are tracked." '211 Patent, col. 4, ll. 51-53. Scanning involves transmitting and tracking "to provide a 3D ultrasound image." '211 Patent, col. 4, ll. 58-63.

The function of tracking through the first portion of the volume requires only the structures necessary to track beams and produce the scan lines. Structures involved in that function include the beamformer, processor and address generator.

The beamformer is clearly linked to the function of tracking throughout the patent. '211 Patent, col. 5, ll. 39-43 ("The beamformer 500 also tracks the transmit ultrasound beams . . . downstream until they reach respective points . . . in the volume 540 which lie in a plane of the volume 540 that corresponds to the selected slice 545. The tracking of the transmit ultrasound beams produces ultrasound scan lines which are used to provide a 3D data set which is stored in a memory 560.); col. 7, ll. 14-16 ("The beamformer 500 tracks the transmit ultrasound beams . . . to provide the 3D data set which is stored in memory 560."); col. 7, ll. 31-33 ("The beamformer 500 tracks the transmit ultrasound beams . . . to provide the 3D data set which is stored in the memory 560."); col. 7, ll. 58-62 ("The beamformer 500 tracks the transmit ultrasound beams . . . (under the control of the processor 550) downstream until they reach respective points 831*b*, 831*c* in the volume 640 which lie in a plane that corresponds to the selected C slice 801."); col. 8, ll. 56-58 ("[T]he beamformer 500 uses parallel processing to form a plurality of ultrasound scan lines for each transmit ultrasound beam."). The processor is also required to ensure that tracking occurs "until the plurality of transmit ultrasound beams reach respective locations in the at least one slice." '211 Patent, col. 3, ll. 41-44 ("A processor determines the locations of the selected slices in the volume. An [sic] processor controls the tracking of the transmit ultrasound beam based on the locations of the selected slices."); col. 5, ll. 54-57 ("In a preferred embodiment, the processor 550

controls the tracking of the transmit ultrasound beams based on the coordinates of the plane."); col. 6, ll. 53-56 ("The beamformer 500 tracks the transmit ultrasound beams . . . (under the control of the processor 550) downstream until they reach respective points . . . in the volume 640 that corresponds to the selected slices"); col. 7, ll. 58-62 ("The beamformer 500 tracks the transmit ultrasound beams . . . (under the control of the processor 550) downstream until they reach respective points . . . in the volume 640 which lie in a plane that corresponds to the selected C slice 801."); col. 8, l. 65-col. 9, l. 3 ("For example, in the embodiment of FIG. 6, the processor 550 controls the beamformer 500 so that the transmit ultrasound beams . . . are tracked downstream from the ultrasound transducer 520 to the selected slice 545, whereupon the processor 550 stops the tracking of the transmit ultrasound beams."); col. 9, ll. 29-63 ("The processor 550 determines the time needed for the transmit ultrasound beams . . . to reach the respective points . . . in the plane . . . . in the embodiments of FIGS. 5, 6, and 8, the processor 550 determines the total propagation time for a pressure wave to propagate along a line from the ultrasound transducer 520 to a corresponding point in the plane . . . . Accordingly, reflected pressure waves received later from the same transmitted pressure wave are not tracked"); col. 9, ll. 63-65 ("[T]he processor 550 controls the tracking of the ultrasound scan lines . . . .").

The processor's role in tracking thus relates to controlling the beamformer. The flowchart in FIG. 9C illustrates the function of the processor in terms of setting up the system to track the beams to the relevant points in the volume and is the disclosed

algorithm in the patent. The algorithms and flowchart are discussed in column 9, lines 39-53 and column 11, line 18 to column 12, line 15.

The address generator is mentioned as a structure that may be used to control tracking. The address generator's role in tracking is described in column 5 of the patent: "It will be understood that the tracking may be controlled by an address generator 565 wherein the coordinates of the plane are used by the processor to determine how long the transmit ultrasound beams are tracked." Col. 5, ll. 60-64. Neither VMI nor Siemens provided any explanation for the role of the address generator in the overall technology at issue in the '211 patent. The '807 patent discusses an "output address generator" as a part of the scan converter which

> selects the echo data and respective coordinates originating from the selected scanned object and displays the data as brightness levels to produce an image of the projected slice on a monitor screen. The operation with the address generator also involves modifying the displayed image corresponding to the selection of the viewing direction.

'807 Patent, col. 5, ll. 21-27. Neither party adequately explained the role of the address generator with respect to its role in the '807 patent or the '211 patent, but their roles appear to be different based on the language describing them in each patent. Nevertheless the specification indicates a clear intent to link the address generator to the function of tracking in the preferred embodiment and thus will be included as structure corresponding to tracking.

Siemens seeks to include the memory as part of the structure associated with tracking. The specification discusses memory in conjunction with what occurs *after*

tracking. The scan lines produced by tracking are stored in the memory. '211 Patent, col. 5, ll. 44-50 ("The tracking of the ultrasound beams produces ultrasound scan lines which are used to provide a 3D data set which is stored in a memory 560. The processor 550 accesses the data included in the 3D data set that represents the selected slice 545. The accessed data is provided to the display 570 which generates a view of the selected slice.").

Memory is referenced throughout the specification as something used after tracking. In column 6, the specification states that "[t]he address generator 565 determines the addresses needed to retrieve data from the 3D data set stored in the memory 560. . . . The needed data is provided to the display 570 to display views of the selected slices." '211 Patent, col. 6, ll. 7-11. Later in column 6, the memory is again referenced: "The tracking produces the 3D data set that is stored in the memory 560 . . . . The processor 550 accesses data included in the 3D data set that represents the selected l slices 601, 602. The accessed data is provided to the display 570 that generates views of the selected slices 601, 602." Finally, column 7 notes that the "beamformer 500 tracks the transmit ultrasound beams . . . to provide the 3D data set which is stored in the memory 560," and "the beamformer 500 tracks the transmit ultrasound beams . . . to provide the 3D data set which is stored in the memory 560." '211 Patent, col. 7, ll. 14-17, 30-33. Thus, each time the memory is referenced, it is referenced as "memory 560" and as something that

is used *after* tracking has taken place.[6]

Siemens also attempts to limit the claim scope to I and C slices. As discussed previously, the claim does not require such a limitation.

The structure associated with the function of tracking is thus the **beamformer 500, address generator 565, and processor 550, the processor 550 programmed with an algorithm for controlling the beamformer 500 and scanning only a portion of the volume defined by a configuration selected by the viewer for viewing, as described in col. 9, ll. 29 to col. 10, l.50 and col. 11, l. 18 to col. 12, l. 15, and shown in FIG. 9C.**

"means for scanning"

Finally, claim 18 describes a "means for scanning a first portion of the volume defined by the at least one slice that is less than the volume at a scan rate that is based on a ratio of a volume of the first portion to the volume by eliminating scanning of a second portion of the volume that is separate from the first portion." As noted above, the "means for scanning a first portion of the volume" in claim 18 comprises the "means for transmitting" and "means for tracking." Scanning is described in the specification:

> The term 'scanning' or 'scanned' refers to the transmission of ultrasound beams into a volume and tracking the transmit ultrasound beams in the volume to provide a 3D ultrasound image. For example, a 3D ultrasound image of a volume may be provided by entirely scanning the volume with

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[6] Another type of memory related to the general memory in a computer is referenced in column 11, line 56 and 63.

> a first scan followed by entirely scanning the volume with a second scan and so on.

'211 Patent, col. 4, ll., 58-65. The parties disagree on the function and structure. VMI contends that the function is "means for scanning a first portion of the volume defined by the at least one slice that is less than the volume." Siemens argues that the language in the claim regarding the scan rate ("at a scan rate that is based on a ratio of a volume of the first portion to the volume by eliminating scanning of a second portion of the volume that is separate from the first portion") should also be included as part of the function.

The language in the claim regarding the scan rate merely describes the result of scanning only a portion of the volume. Therefore, it will not be included and the function is **"means for scanning a first portion of the volume defined by the at least one slice that is less than the volume."**

The structure associated with the "means for scanning" clearly includes all of the structures previously discussed that are associated with transmitting and tracking. In addition, scanning provides the entire 3D ultrasound image. Therefore, the memory and display are included. '211 Patent, col. 5, ll. 44-50; col. 6, ll. 57-64; col. 7, ll. 14-17, col. 7, ll. 31-33.

Therefore, the structure clearly linked to the "means for scanning" includes: **an ultrasound transducer, beamformer 500, address generator 565, and processor 550, which may be a computer workstation or a personal computer or a processor dedicated to controlling the overall operation of the 3D ultrasound imaging system and**

programmed with an algorithm for controlling the beamformer 500 as described in column 9, ll. 29 - col. 10, l. 50 and col. 11, l.18-col. 12, l.15, and in FIG. 9C; memory 560 and display 570, which may comprise a Cathode Ray Tube (CRT), Liquid Crystal Display (LCD) or other display known to those having skill in the art.

IV.

For the foregoing reasons, the claims presented for construction are determined as set forth in this Memorandum Order. The constructions of the above terms are presented in chart form at the end of this Memorandum Opinion.

This the 30th day of December, 2011.

/s/ N. Carlton Tilley, Jr.
Senior United States District Judge

'807 Patent Claim Construction Summary

Agreed Constructions:

Claim Number	Claim Term	Stipulated Construction
1	"means for resolving said wave into a plurality of echo data"	Subject to interpretation under 35 U.S.C. § 112 ¶6. *Recited function:* "resolving the wave into a plurality of echo data" *Corresponding structure:* a beamformer
1	"terminal means"	a terminal
1	"means adapted for radiating said object with a plurality of sonic beams"	Subject to interpretation under 35 U.S.C. § 112 ¶6. *Recited function:* "radiating the object with a plurality of sonic beams" *Corresponding Structure:* a transducer consisting of a two dimensional array of piezoelectric elements or a linear array combined with a motorized mechanical scanner

1	"means for displaying said image of said at least one section . . . and displaying each signal as brightness at a respective one of said plurality of display locations corresponding to said image"	Subject to interpretation under 35 U.S.C. § 112 ¶6. *Recited function:* "displaying the image of the at least one section . . . and displaying each signal as brightness at a respective one of said plurality of display locations corresponding to said image" *Corresponding Structure:* a monitor
1, 21	"cross section"	"a planar section formed by cutting through an object"
2	"means for irradiating an entire volume of said object by emitting said plurality of beams in a repeated pattern of directions"	Subject to interpretation under 35 U.S.C. § 112 ¶6. *Recited function:* "irradiating an entire volume of the object by emitting the plurality of beams in a repeated pattern of directions" *Corresponding structure:* a transducer consisting of a two dimensional array of piezoelectric elements or a linear array combined with a motorized mechanical scanner.

4	"I-scan"	"a scan of a slice which has any orientation within the object volume. I-scans are not C-scans or B-scans, but rather are planes cut through the scan volume at an arbitrary angle"
4	"C-scan"	"a scan of a slice parallel to the effective transducer aperture (e.g. Fig. 1A) or of a concave or convex spherical shell (e.g. Figs. 1B, 1C)"
4	"B-scan"	"a scan of a slice that extends from the transducer toward the scan range"
21	"means for displaying said echo data as brightness on a display screen"	Subject to interpretation under 35 U.S.C. § 112 ¶6. *Recited Function*: "displaying the echo data as brightness on a display screen" *Corresponding Structure:* a monitor

'807 Claim Construction (disputed constructions)

Claim number	Term	Construction
1, 21	simultaneously displaying in real time, an image of at least one section of variable thickness of a three dimensional object simultaneously displaying in real time, an image of at least one cross section of a three dimensional object	displaying in real time one image or multiple simultaneous images of at least one section of variable thickness of a three dimensional object displaying in real time one image or multiple simultaneous images of at least one cross section of a three dimensional object
1,21	real time	the absence of significant perceptible lag between user selection, acquisition, and display
1	at least one section of variable thickness	one or more sections having a thickness that may or may not be uniform
1, 21	sonic beam	an acoustic beam that insonifies an object but not necessarily the entire object
1, 21	region	a portion of the object
1,21	storing	putting or retaining in a memory unit
1,21	matching	causing to correspond to
1,21	transferring	conveying or moving from one place to another
1,21	intensity of reflection	strength of the reflected wave
21(c)	said first plurality of memory addresses	a set of memory addresses corresponding to all locations in an object

21(c)	first plurality of locations in said object	all locations in an object from which an echo has been received by the beamformer
21(b)	second plurality of locations	locations in an object that correspond to a selected cross section of the object
21(c)	second plurality of memory addresses	a set of memory addresses corresponding to the second plurality of locations
19	means for calculating a hypothetical value of echo datum	Function: calculating a hypothetical value of echo datum Structure: a filter
20	means for calculating a hypothetical value of echo data	Function: calculating a hypothetical value of echo data Structure: a filter
3	means for generating said plurality of beams as groups of beams, each beam in each group having an azimuthal angle advanced over a next previous beam in said each group	Function: generating said plurality of beams as groups of beams, each beam in each group having an azimuthal angle advanced over a next previous beam in said each group Structure: phased array transducer
1	scan converter means	scan converter
1	buffer memory means	buffer memory

1	address pointer means	Function: matching each buffer memory address in the memory of the scan converter belonging to the set of memory addresses in the scan converter memory and transferring to each buffer memory address the datum stored in the memory address of the scan converter memory respectively Structure: Output Address Generator 28 and data paths shown in FIG. 9 between 26A and 26B and 30A and 30B
1	means operated by said viewer for selecting a set of addresses in said scan converter memory of said scan converter corresponding to said at least one section in said object selected by said viewer	Function: selecting a set of addresses in the scan converter memory of the scan converter corresponding to the at least one section in the object selected by a viewer Structure: an operator controlled device such as a track ball, light pen, or mouse combined with the pyramidal icon 17; display 34; host controller 76; and interactive software programmed with an algorithm for providing pyramidal icon 17 and obtaining a user selection of display slices from that pyramidal icon as described in col. 7, ll. 56-col. 8, l. 32 and FIG. 3B

1	means for providing data stored in said buffer memory address to said terminal means of said display means	Function: providing data stored in the buffer memory address to the terminal of the display Structure: the data path shown in FIG. 9 between Video Frame 30A and 30B of display 34

'211 Patent claim construction summary

Agreed Constructions:

3, 18	scanning	transmitting ultrasound beams into a volume and tracking the transmit ultrasound beams in the volume to provide a 3D ultrasound image
3, 18	tracking	the use of parallel receive processing to form ultrasound scan lines from the transmit ultrasound beams transmitted into the volume
3, 18	portion	a part of a whole; an amount, section, or piece of something
3, 18	scan rate	the number of times the volume or portion thereof is scanned per unit of time
3, 18	ultrasound scan line	echo data corresponding to a line within the volume
3, 18	slice	section made by a plane cutting anything transversely

'211 Patent Claim Construction (disputed constructions)

Claim Number	Term	Construction
3, 18	scan range	a distance from the transducer sufficient to encompass - i.e. envelop - the slice or slices selected

18	means for selecting at least one slice of the volume	Function: selecting at least one slice of the volume Structure: a user interface 555 (either a track ball, light pen, mouse, tablet, keyboard or other input device), display 570, which may be either a cathode ray tube (CRT) or a liquid crystal display (LCD), and processor 550. The processor 550 may be a computer such as an engineering workstation or a personal computer or a processor, programmed with an algorithm for obtaining user input selecting a configuration of slices from a plurality of configurations and determining the locations of the selected slices in the volume based upon the selected configuration, as described at col. 9, ll. 14-54.

18	means for transmitting	Function: transmitting a plurality of transmit ultrasound beams downstream from an ultrasound transducer through the at least one slice of the volume to a scan range of the volume Structure: an ultrasound transducer, beamformer 500, and processor 550, which may be a computer workstation or a personal computer or a processor dedicated to controlling the overall operation of the 3D ultrasound imaging system and programmed with an algorithm for controlling the beamformer 500 as described in column 9, l. 19-col. 10, l. 50 and col. 11, l. 18 to col. 12, l. 15, and in FIG. 9C

18	means for tracking	Function: tracking the plurality of transmit ultrasound beams downstream from the ultrasound transducer through the first portion of the volume to form a plurality of ultrasound scan lines until the plurality of transmit ultrasound beams reach respective locations in the at least one slice Structure: beamformer 500, address generator 565, and processor 550, the processor 550 programmed with an algorithm for controlling the beamformer 500 and scanning only a portion of the volume defined by a configuration selected by the viewer for viewing, as described in col. 9, ll. 29 to col. 10, l. 50 and col. 11, l. 18 to col. 12, l. 15, and shown in FIG. 9C

18	means for scanning	Function: scanning a first portion of the volume defined by the at least one slice that is less than the volume at a scan rate that is based on a ratio of a volume of the first portion to the volume by eliminating scanning of a second portion of the volume that is separate from the first portion Structure: an ultrasound transducer, beamformer 500, address generator, and processor 550, which may be a computer workstation or a personal computer or a processor dedicated to controlling the overall operation of the 3D ultrasound imaging system and programmed with an algorithm for controlling the beamformer 500 as described in column 9, ll. 29-col. 10, l. 15 and col. 11, l. 18-col. 12, l.15, and in FIG. 9C; memory 560 and display 570, which may comprise a Cathode Ray Tube (CRT), Liquid Crystal Display (LCD) or other display known to those having skill in the art